ELECTRIEL

INNOVATE ENVIRONMENT

UKKO MPPT-10

/USER MANUAL

Document Version 1.1

Electriel Ltd
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Finland

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1 Introduction

Thank you for choosing **UKKO MPPT** for your solar charge controller! The UKKO MPPT is an advanced Maximum Power Point Tracking (MPPT) technology using solar charge controller that is designed for easy plug n' play usage. MPPT technology helps to maximize the energy production and it can increase the production up to 25 % compared to standard PWM solar chargers.

Large touch screen user panel gives easy access to information about the installed solar energy system. Use it to monitor battery condition, energy production, battery and solar panel voltage and charging current.

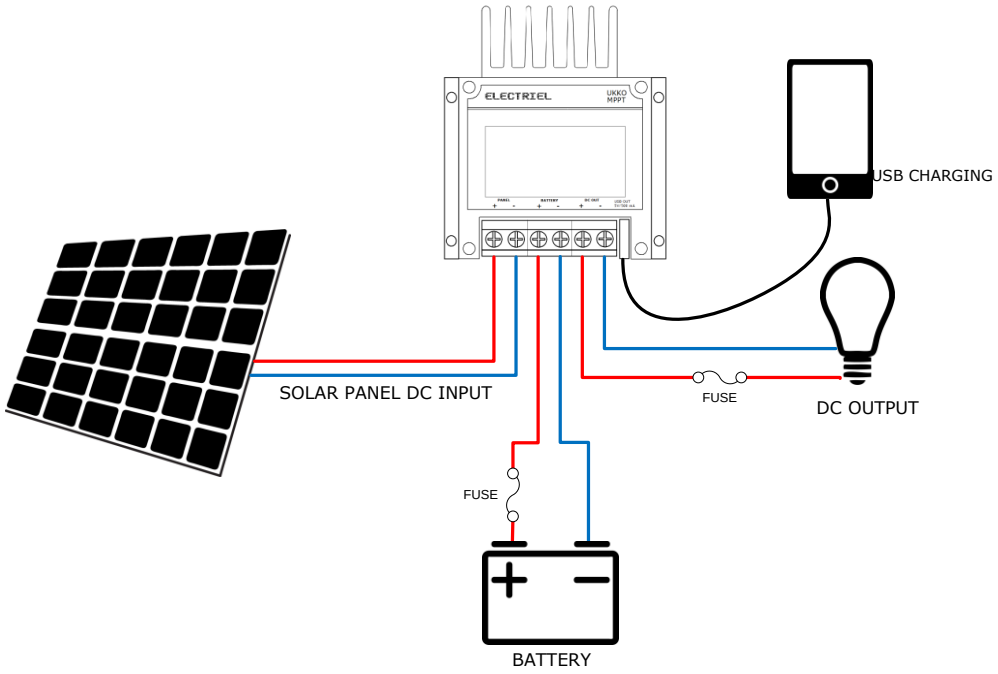


Figure 1. System Overview

UKKO Manager PC Software is used to configure and customize the settings of UKKO MPPT. It features visual presentation of the system data and gives you further control over the energy production. UKKO Manager is available free of charge from Electriel's website and can be used with any PC via USB cable. No additional accessories required

UKKO MPPT is made for easy plug n' play installation. To have clear understanding of the benefits of the controller we encourage you to take time to read this user manual before installation and use of the device.

NOTE: Product warranty is void should you fail to follow the instructions of this manual! The manufacturer is not liable for any harm or lose caused by misuse of the device.

2 Product Features

2.1 Product Overview

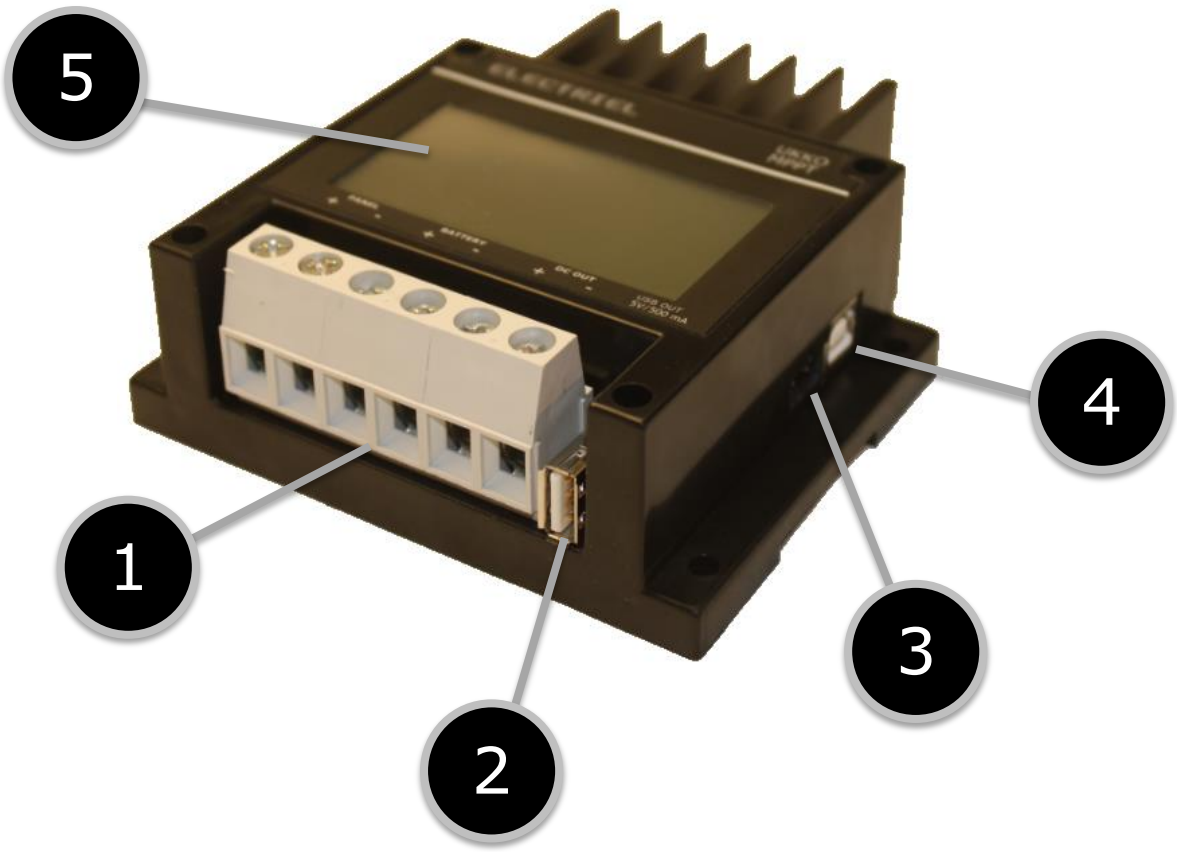


Figure 2. UKKO MPPT Main Parts

1. **Power Screw Terminal**
   Power terminations for solar, battery and load.
2. **USB Connector for Mobile Charging**
   Mobile devices can be charger directly via this USB connector.
3. **Temperature Sensor Connector**
   Connection for optional remote battery temperature sensor.
4. **USB Connector for PC**
   This USB connector provides connection to PC. UKKO Manager PC software can be downloaded from Electriel's website for more careful monitoring of your solar system.
5. **Touch Screen**
   In operation mode the display shows graphs of energy production, battery voltage, solar panel voltage, current, power and battery charge state. Touch the display briefly to turn on the backlight. Backlight will turn off automatically after one minute. Touch the screen for 5 seconds to enter the menu.

2.2 Technical Specifications

ELECTRICAL

- Nominal battery Voltage: 12 / 24 Volts (Auto Detect)
- Max. Battery Voltage: 16 / 32 Volts
- Nominal Charging Current: 10 / 5 Amps
- Max. Solar Panel Voltage: 75 Volts
- Nominal Max. PV input: 200 W
- Peak Efficiency: 97 %
- USB Output Max. Current: 500 mA
- Load Output Max. Current: 20 A

ENVIRONMENT

- Operating Temperature: –15 °C to +60 °C
- Storage Temperature: –20 °C to +70 °C
- Humidity: 90 % non-condensing

ELECTRONIC PROTECTION

- Solar Panel Over Load
- Solar Panel Over Voltage
- Battery Reverse Polarity
- Battery Over Voltage
- High Heat Sink Temperature
- High Battery Temperature
- Lightning and other transients
- Reverse Current at Night

PHYSICAL

- Dimensions: 115 mm x 126mm
- Weight: 370 g
- Mounting: 4 x 5 mm mounting holes
- Materials: Plastic /die cast aluminium
- Protection Standard: IP20
- Screw Terminals: Max. 20 mm^2 / 6 AWG
- USB Connectors: Type A and Type B

BATTERY CHARGING

- Battery Types: Gel, Sealed, AGM, Flooded, Custom
- Charging Modes: Bulk/Boost, Absorption, Float, Equalize (optional)
- Temperature Compensation: -5mV/°C/Cell (or adjustable)
- Compensation Range: -30 °C to +60 °C

CONFORMANCE

This device

- Meets requirements for CE marking.
- Conform the following directives
  EMC Directive: 2004/108/EC
  RoHS Directive: 2002/95/EC
  WEEE Directive: 2002/96/EC
  LVD Directive: 2006/95/EC

  According to following relevant standards
  Immunity: IEC61000-6-2:2005
  Emissions: IEC61000-6-2:2006
  Safety: EN60335-1 and EN60335-2-29

CE

2.3 Optional Accessories

2.3.1 Remote Temperature Sensor

To achieve optimal charging performance it is advised to measure battery temperature. Battery temperature should be compensated, if battery temperature varies from normal room temperature (20 °C) more than ±5 °C. Battery temperature sensor (model: BTS10) is available as an optional accessory.

Battery temperature sensor can be installed at any time. UKKO MPPT will automatically recognize the sensor and activate it. Standard cable length is 5 m (16.7 ft) but it can be extended up to 30 m (100 ft).

Figure 3. Battery Temperature Sensor (Model: BTS10)

2.3.2 UKKO Manager (PC Software)

The *UKKO Manager* PC software is available free of charge from Electriel's website. Use it to monitoring your solar system or modify the settings of the device.

For more information see page 18.

3 Installation Instructions

This chapter describes how to install and configure UKKO MPPT solar charger.

3.1 Important Safety Information

This manual contains important safety information. Read it carefully before installing and using UKKO MPPT solar charger.

General Safety Information

- UKKO MPPT solar charger does not have parts that need service. Do not attempt to repair the device.
- Disconnect solar panel before disassembling UKKO MPPT. This is done by disconnecting the solar panel wires from the device or via the device menu (Disable Charging).
- Confirm that power connections polarity is correct.
- Confirm that power connections are tightened to avoid loose connections from causing excessive heating.
- Protect the device from water and moisture.

3.2 Mounting

Step 1: Choose Mounting Location

Install UKKO MPPT on a vertical surface and protect it from direct sunlight, high temperatures and water (rain). Have minimum of 20 cm of free space above the heat sink to ensure proper cooling.

Step 2: Mark and Drill holes

Use pen or pencil to mark four holes to the mounting surface. Drill 2,5 mm (3/32”) holes in the marked locations.

Step 3: Secure UKKO MPPT

Place the device on the surface and use four mounting screws to secure the device.

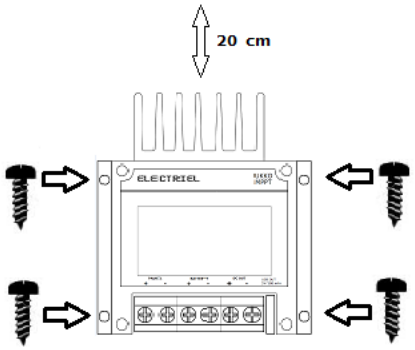


Figure 4. Mounting the UKKO MPPT

3.3 Wiring

Step 1: Connect the Load

DC OUT connector provides battery voltage for the system. Connect positive (+) and negative (-) load wires to the load or load distribution panel and DC OUT connector. An USB load can be plugged at this point and it can be used as a standard USB charger output.

An in-line fuse holder should be wired in series with load as shown in figure 5.

NOTE: Do not insert a fuse into fuse holder at this point!

Load current draw cannot exceed 20 A from DC OUT connector.

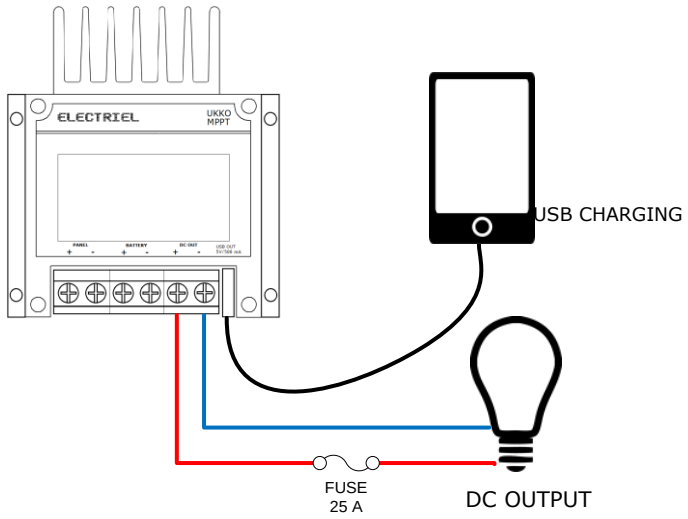


Figure 5. Load Circuit

Step 2: Connect the Battery

Connect positive (+) and negative (-) battery wires to the battery. An in-line fuse holder should be wired in series with load as shown in figure 6. Wire a fuse holder no more than 150 mm (6 inches) from the battery terminal.

NOTE: Do not insert a fuse into fuse holder at this point!

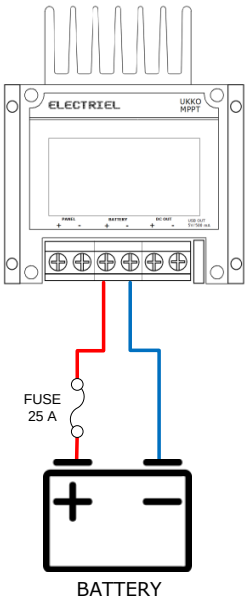


Figure 6. Battery Circuit

Step 3: Connect the Solar Panel

UKKO MPPT accepts 12 V, 24 V or 36 V nominal voltage off-grid solar arrays. If grid-tie solar modules are used, solar panel open circuit voltage (V_{oc}) can be maximum 75 V. Solar panel voltage must be equal or bigger than the battery nominal voltage. Connect positive (+) and negative (-) battery wires to the solar panel and UKKO MPPT as shown in the figure 6.

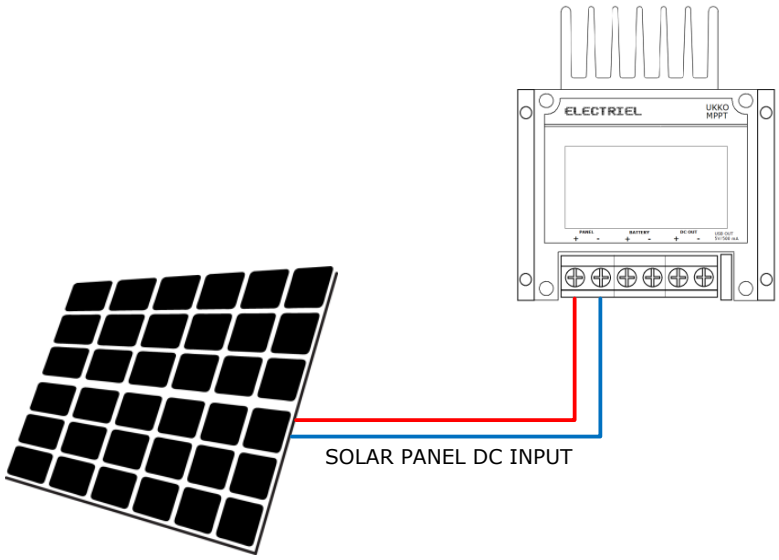


Figure 7. Solar Panel Circuit

If the device is already turned on after connecting the wires and voltage is detected in the solar panel input, UKKO MPPT will wait 30 seconds before starting the charging to avoid sparking in the connector.

Step 4: Accessories (optional)

Install the Battery Temperature Sensor (model: BTS10) if required. The sensor should be mounted as close to the battery as possible.

Step 5: Install Fuses

Install 25…30 A DC rated fuses in each fuse holders in following order:

1. Load
2. Battery

Step 6: Confirm Power-up

UKKO MPPT should now begin the power-up. Check from the device display that is shows product name on the display. After the splash screen statistics of the solar system will appear on the display.

3.4 Configuration Via Device Menu (Optional)

Use the device menu or the PC software (UKKO Manager) to optimize the solar system. This chapter describes how to configure the device via device menu.

Enter the device menu by pressing the touch screen for 5 seconds. Following view should appear when English language is selected. Use the touch screen buttons to browse the menu.

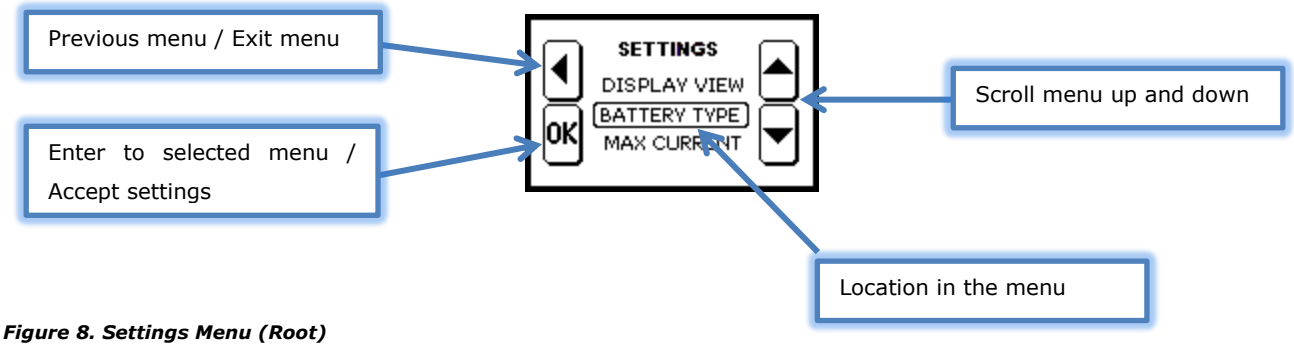


Figure 8. Settings Menu (Root)

3.4.1 Settings

Menu selections

- DISPLAY VIEW (Select the display view mode in normal operation)
- BATTERY TYPE (Select the type of the battery in use)
- MAX CURRENT (The Maximum charging current)
- BACKLIGHT (Set backlight intensity)
- LANGUAGE (Choose the device language)
- CHARGING (Enable or Disable the battery charging and MPPT controller)

3.4.2 Display View

Menu selections

- FUNCTIONAL
- ENERGY
- CURRENT
- POWER
- CHARGE STAGE
- BATTERY VOLTAGE
- PANEL VOLTAGE
- CYCLE VIEWS

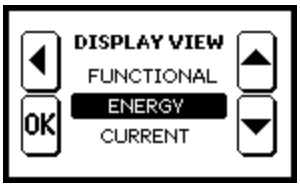


Figure 9. Display View

From the display view menu it is possible to choose what to view on the display during normal operation. When choosing Cycle Views the display view mode will be cycled every three seconds automatically. Selected view mode is indicated with black background as shown in figure 9. Accept selection with OK button or go back to the Settings menu with back button on cancel selection.

3.4.3 Battery Type

Menu selections

- CUSTOM
- GEL (default)
- SEALED 1
- SEALED 2
- AGM/FLOODED
- FLOODED 1
- FLOODED 2
- L-16

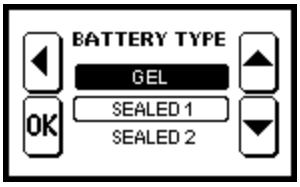


Figure 10. Battery type

Choose a correct battery for the system from the battery type menu. This may be needed for fine tuning and optimizing the system. Each battery type has different voltage limits for boost, floating and

equalizing charge modes. For more detailed information about different battery types, please refer to chapter 4.3 (Battery Charging).

3.4.4 Max Current

Menu selections

- 12 V System: Adjust Charging current 0.5…10 A
- 24 V System: Adjust Charging current 0.5…5 A

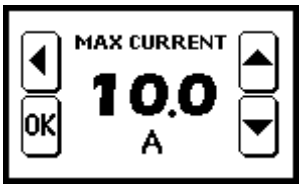


Figure 11. Max Current

Adjust the maximum charging current with 0.1 A steps. If the battery is really small, consider charging with lower current to avoid any damage to battery.

3.4.5 Backlight

Menu selections

- Adjust backlight intensity 0…12 steps

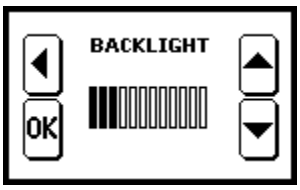


Figure 12. Backlight

The changes in backlight brightness are applied when returning from the menu back to the normal operation mode. Even if backlight is turned off, the backlight will be brightened for a short period of time (60 seconds), when the display is touched briefly during normal operation. The backlight is always on in the menu.

NOTE: backlight consumes battery power, so it is recommended to keep backlight turned off or as dim as possible during normal operation. One bar increases the current consumption roughly 1…2 mA.

3.4.6 Language

Menu selections

- ENGLISH (default)
- FINNISH

Figure 13. Language

Choose UKKO MPPT language.

3.4.7 Charging

Menu selections

- ENABLED (default)
- DISABLED

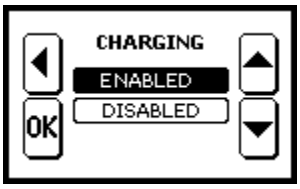


Figure 14. Charging

Turn the battery charging on (Enabled) or off (Disabled) in the Charging menu. The charging is turned off (Disabled) until it is enabled via this menu. Disabling the charging is required during maintenance of the system. Disabling the charging allows disconnecting solar panel(s) safely even if rest of the system is running. After enabling the charging and when voltage is detected in the solar panel input, UKKO MPPT will wait 30 seconds before starting the charging.

4 Operation

4.1 Display

Use the display to monitor the system status and functioning during normal operation. The device menu has the following view options:

a) Functional view
b) Graphs
c) Energy bars
d) Cycle views

Functional View

Functional view (Figure 14) shows instant charging condition and battery charge level.

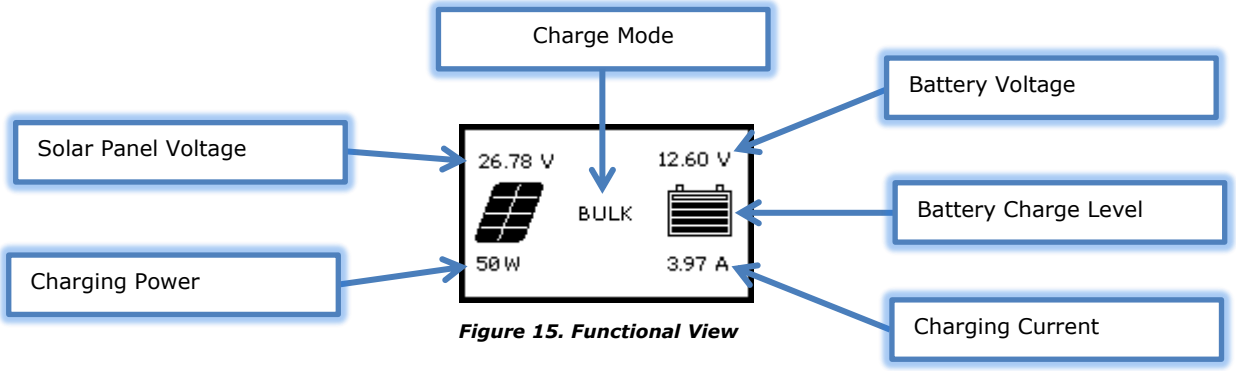


Figure 15. Functional View

Graphs

The UKKO MPPT logs charging data from last 48 hours. From the device menu it is possible to enable the following graphs:

- CURRENT (Charging Current)
- POWER (Output Power)
- CHARGE (Battery Charge Level)
- BATTERY V. (Battery Voltage)
- PANEL (Solar Panel Voltage)

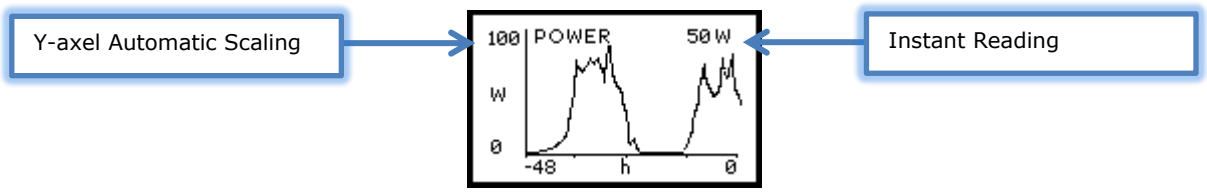


Figure 16. E.g. Power Trend

Energy Bars

The UKKO MPPT logs produced energy per day from last 30 days. Daily energy bars can be viewed as shown in the figure 16.

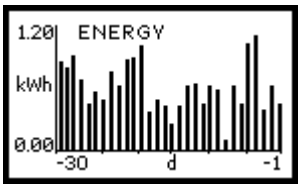


Figure 17. Daily Energy Bars

Cycle Views

Cycle display view mode cycles all seven display views in 3 second intervals.

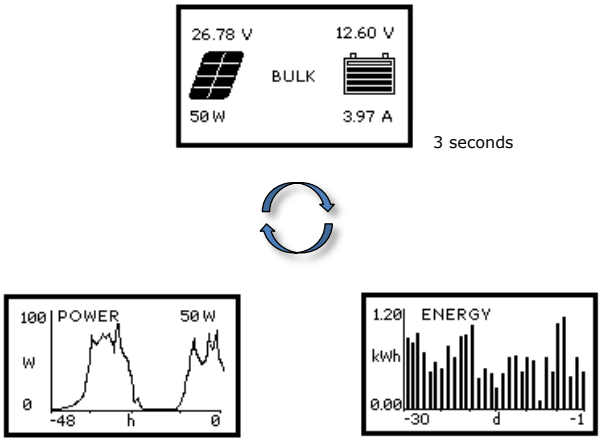


Figure 18. Cycle All Seven Views

4.2 Maximum Power Point Tracking

The UKKO MPPT uses advanced Maximum Power Point Tracking (MPPT) algorithm, which guarantees the solar panel is always loaded with optimal power. The tracking feature increases energy production up to 15…40 % compared to standard PWM solar charger. See a typical I-V curve of a 12 V solar module below.

The maximum power point of the solar panel depends on sun light intensity, temperature, solar panel partial shading and solar panel type. UKKO MPPT tracks the maximum power point automatically, regardless of environmental conditions or solar panel type.

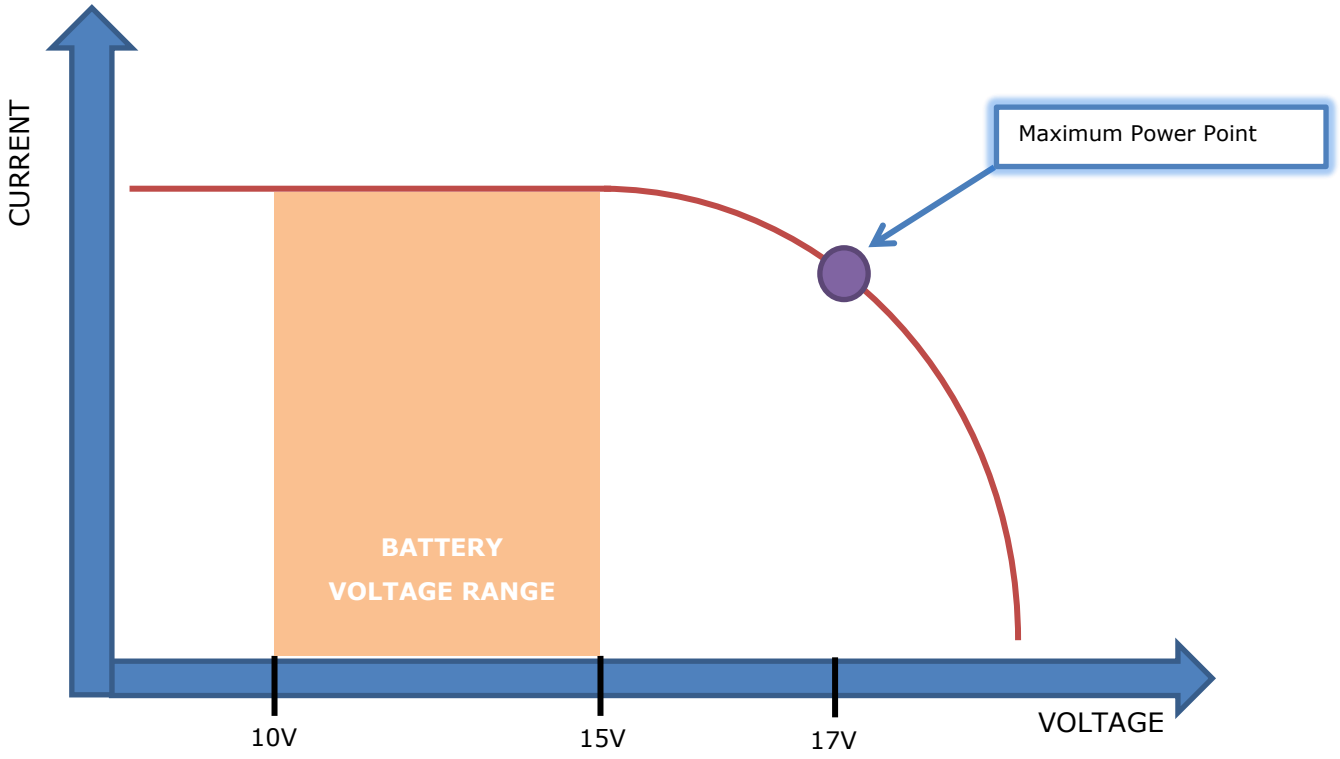


Figure 19. Nominal 12 V Solar Panel I-V Curve

4.3 Battery Charging

4.3.1 Battery Charging Modes

The device has four different charging modes.

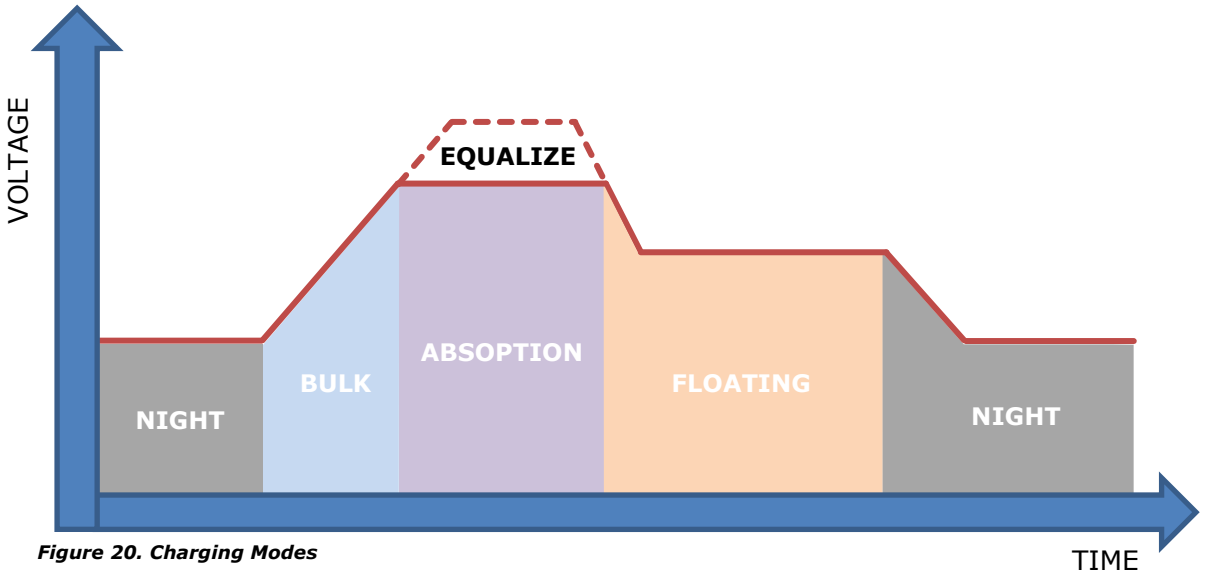


Figure 20. Charging Modes

Bulk Charge

UKKO MPPT starts bulk charging, when solar panel voltage is higher than battery voltage. At this point the device delivers 100 % of available power from the solar panel to the battery. This is sometimes referred to as "boost charge".

Absorption Charge

When the battery voltage has reached the absorption voltage set-point, the device will maintain the absorption voltage level until the battery is fully charged. The duration of the absorption charge is typically two hours and it is carried out once per day.

Floating

After absorption charge, the battery voltage will be decreased to floating level to keep the battery fully charged.

Equalize

When equalize battery function is enabled (possible with flooded or custom battery settings), the battery voltage will be periodically raised above absorption voltage. Typically, the equalization cycle takes three hours and is carried out every 28 days. This is done to prevent the battery electrolyte stratification. It also helps to equalize cell voltages inside the battery.

CAUTION! RISK OF EXPLOSION

Equalizing batteries may produce explosive gasses. The battery bank must be properly vented. Please confirm with the battery manufacturer what the requirements for batteries are in your system, before using the equalizing feature. Equalizing that lasts too long or has too high voltage may seriously damage the battery.

4.3.2 Battery types

Choose the correct battery type from the device menu or PC software. UKKO MPPT has seven different pre-programmed battery types and one custom battery. Custom battery can be adjusted only via PC software. Following table shows different voltage limits and settings for each individual battery type. Multiply table voltages by two to apply it into 24 V system.

Table 1. Battery Types

	Custom	Gel	Sealed 1	Sealed 2	AGM/ Flooded	Flooded 1	Flooded 2	L-16
Bulk Connect	12,2	12,2	12,2	12,2	12,2	12,2	12,2	12,2
Bulk Maximum	14,2	14	14,15	14,3	14,4	14,6	14,7	15,4
Float Voltage	13,8	13,7	13,7	13,7	13,7	13,5	13,5	13,5
Equalization Voltage Connect	12,2	0	12,2	12,2	12,2	12,2	12,2	12,2
Equalization Voltage Maximum	15	0	14,4	14,6	15,1	15,3	15,4	15,6
Absorption Duration (minutes)	150	150	150	150	180	180	180	180
Equalization Duration (minutes)	0	0	60	60	120	120	180	180
Equalization Interval (0 = never) (days)	0	0	28	28	28	28	28	14

5 PC Software

Use the *UKKO Manager* PC software to monitor energy production, battery status and other logging and measuring information. Configuring the UKKO MPPT parameters can also be performed via the PC software. The software is compatible with standard Windows PC. USB cable is required to connect to UKKO MPPT converter. *UKKO Manager* is available free of charge from Electriel's website.

5.1 Requirements

For using the *UKKO Manager* your computer should meet these system requirements.

- Windows Vista, Windows 7, 8 or 8.1 (does not work on Windows RT)
- 1 gigahertz (GHz) or faster 32-bit (x86) or 64-bit (x64) processor
- 1 gigabyte (GB) RAM (32-bit) or 2 GB RAM

5.2 Installing the UKKO Manager

UKKO Manager can be installed after downloading the latest setup file from Electriel's website.

Step 1: Launch the executable setup file.

Step 2: Install Microsoft .NET Framework.
At first installation program will ask to install Microsoft .NET Framework. If Framework already exists on the computer this step is automatically skipped. To continue, click Install.

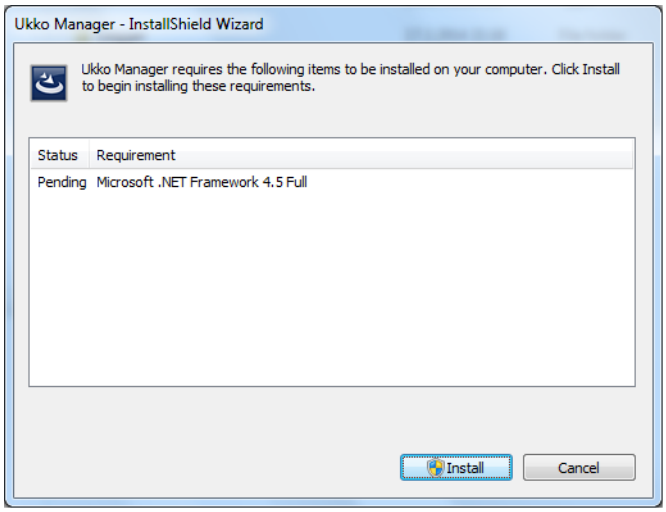

Ukko Manager - InstallShield Wizard
Ukko Manager requires the following items to be installed on your computer. Click Install to begin installing these requirements.
Status
Requirement
Pending
Microsoft .NET Framework 4.5 Full
Install
Cancel

Figure 21. Install Microsoft .NET Framework

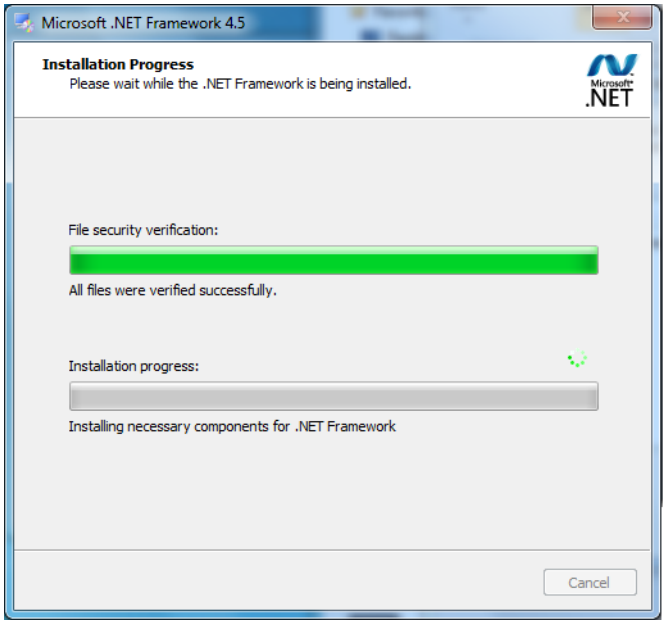

Microsoft .NET Framework 4.5
Installation Progress
Please wait while the .NET Framework is being installed.
File security verification:
All files were verified successfully.
Installation progress:
Installing necessary components for .NET Framework
Cancel

Figure 22. Installing the Micoroft .NET Framework

Step 3: Install *UKKO Manager*. To continue, click Next.

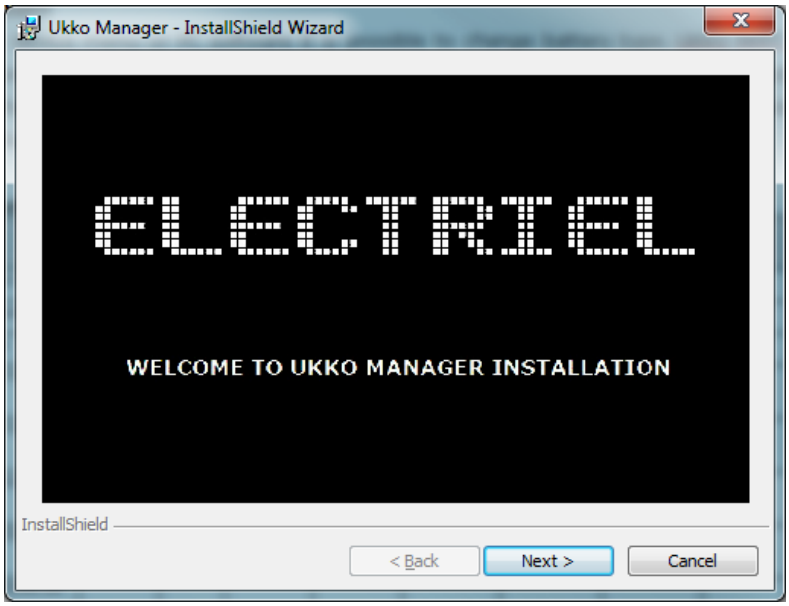


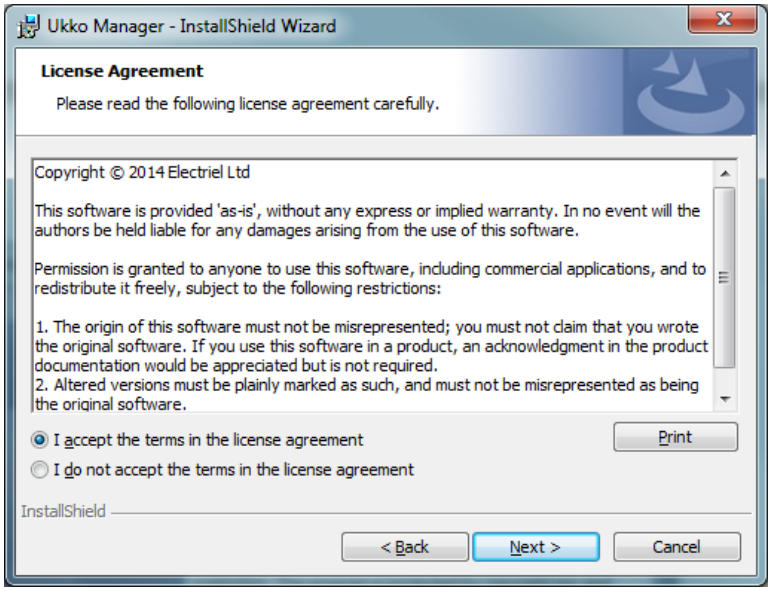
Figure 23. The UKKO Manager Installation

Step 4: InstallShield Wizard Welcome window. To continue, click Next.

Ukko Manager - InstallShield Wizard
Welcome to the InstallShield Wizard for Ukko Manager
The InstallShield(R) Wizard will install Ukko Manager on your computer. To continue, click Next.
WARNING: This program is protected by copyright law and international treaties.
< Back
Next >
Cancel

Figure 24. Ready to Install

Step 5: InstallShield Wizard Welcome window. To continue, read and accept the terms in the license agreement and click Next.


Ukko Manager - InstallShield Wizard
License Agreement
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2. Altered versions must be plainly marked as such, and must not be misrepresented as being the original software.
I accept the terms in the license agreement
I do not accept the terms in the license agreement
Print
InstallShield
< Back
Next >
Cancel

Figure 25. License Agreement

Step 6: Choose installation destination folder. Default folder will be created under "Program Files". To continue, click Next.

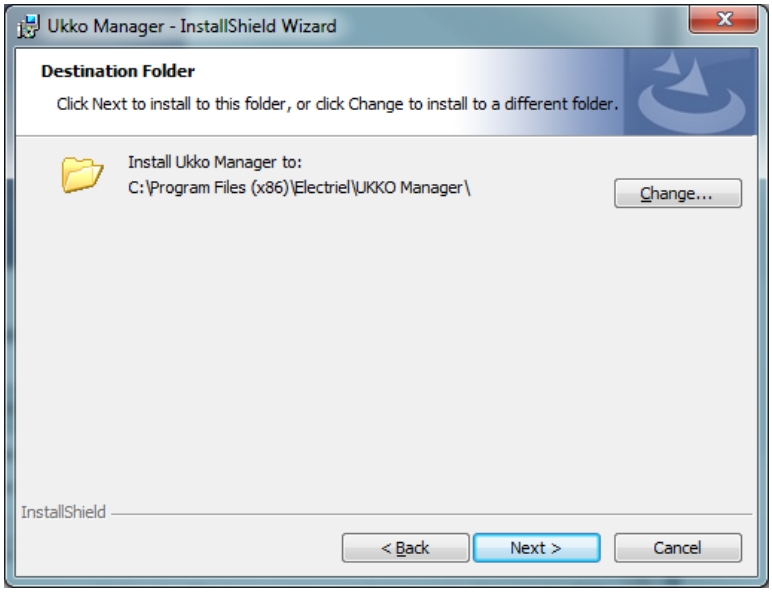
Ukko Manager - InstallShield Wizard
Destination Folder
Click Next to install to this folder, or click Change to install to a different folder.
Install Ukko Manager to:
C:\Program Files (x86)\Electriel\UKKO Manager\
Change...
InstallShield
< Back
Next >
Cancel

Figure 26. Destination Folder

Step 7: Ready to begin installation. To continue, click Next.

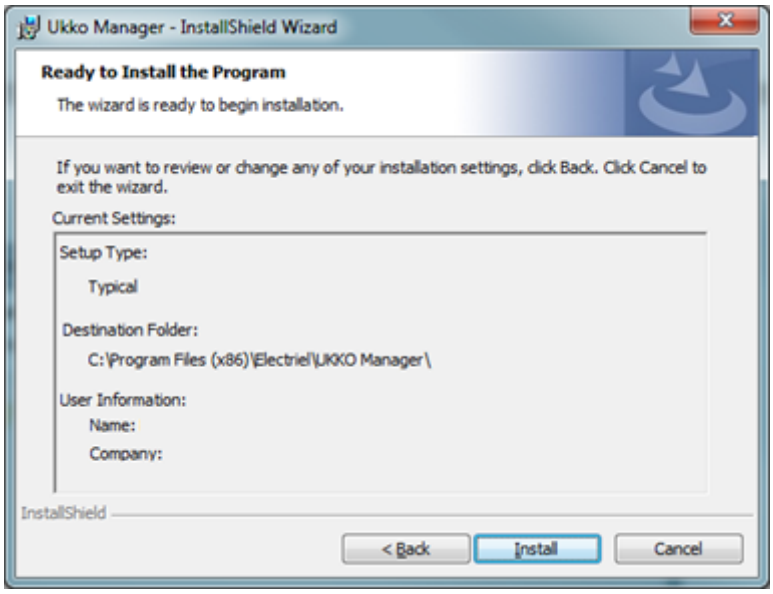

Figure 27. Ready to Install

Step 8: Wait until installation status bar has completed.

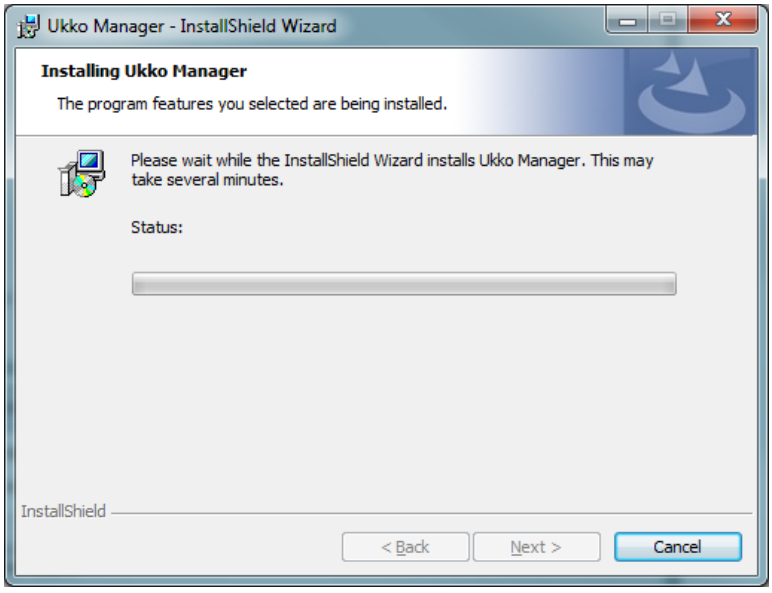
Ukko Manager - InstallShield Wizard
Installing Ukko Manager
The program features you selected are being installed.
Please wait while the InstallShield Wizard installs Ukko Manager. This may take several minutes.
Status:
InstallShield
< Back
Next >
Cancel

Figure 28. Installing Program Files

Step 9: Install an USB Device Driver. The USB driver is needed in order to utilize communication between UKKO MPPT (device) and UKKO Manager (PC software). To continue, click Next.

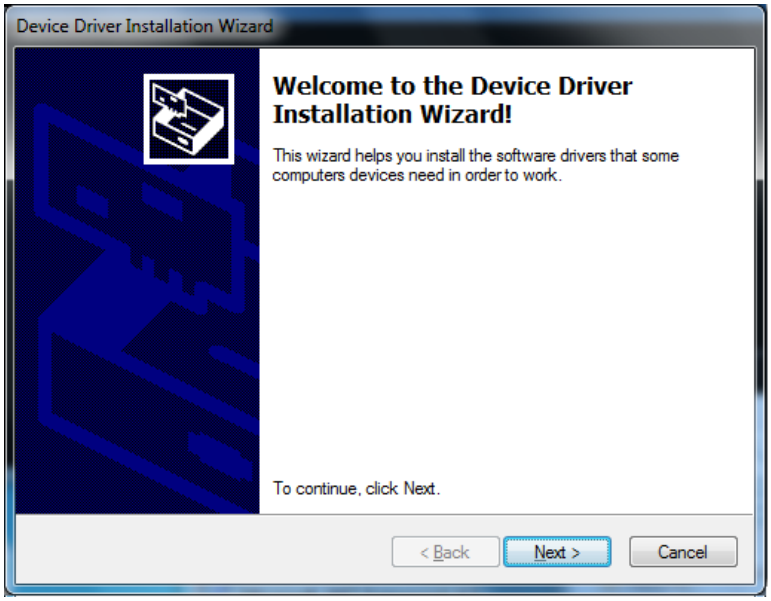
Device Driver Installation Wizard
Welcome to the Device Driver Installation Wizard!
This wizard helps you install the software drivers that some computers devices need in order to work.
To continue, click Next.
< Back
Next >
Cancel

Figure 29. Driver Installation Wizard

Step 10: Windows Security may ask for a confirmation for the driver installation. To continue, click Install.

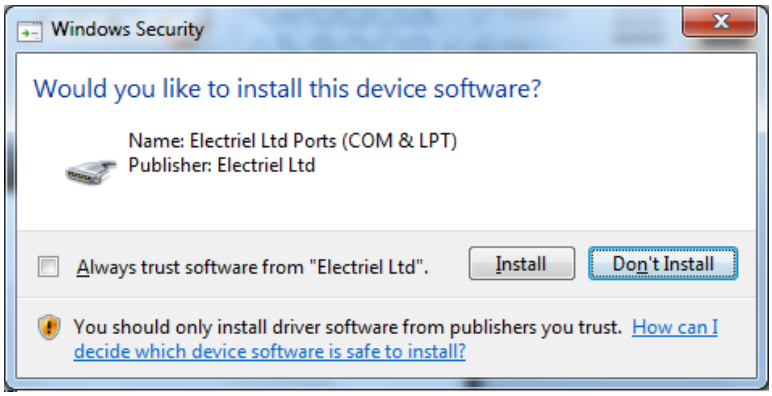
Windows Security
Would you like to install this device software?
Name: Electriel Ltd Ports (COM & LPT)
Publisher: Electriel Ltd
Always trust software from "Electriel Ltd".
Install
Don't Install
You should only install driver software from publishers you trust. How can I decide which device software is safe to install?

Figure 30. Windows Security Pop-up

Step 11: Driver installation is completed. To continue, click Finish.

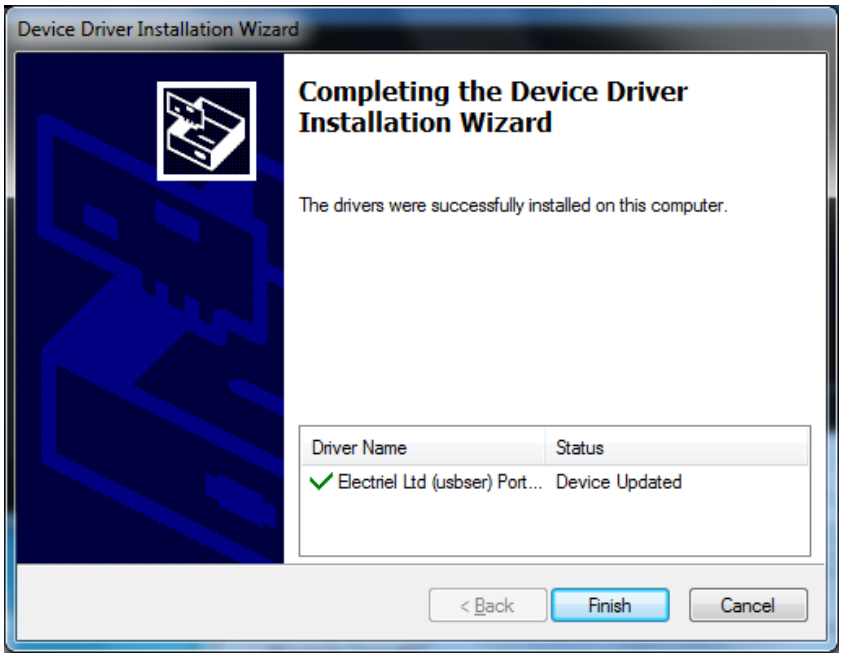

Figure 31. Driver Installation Completed

Step 12: The UKKO Manager installation is completed. To continue, click Finish.

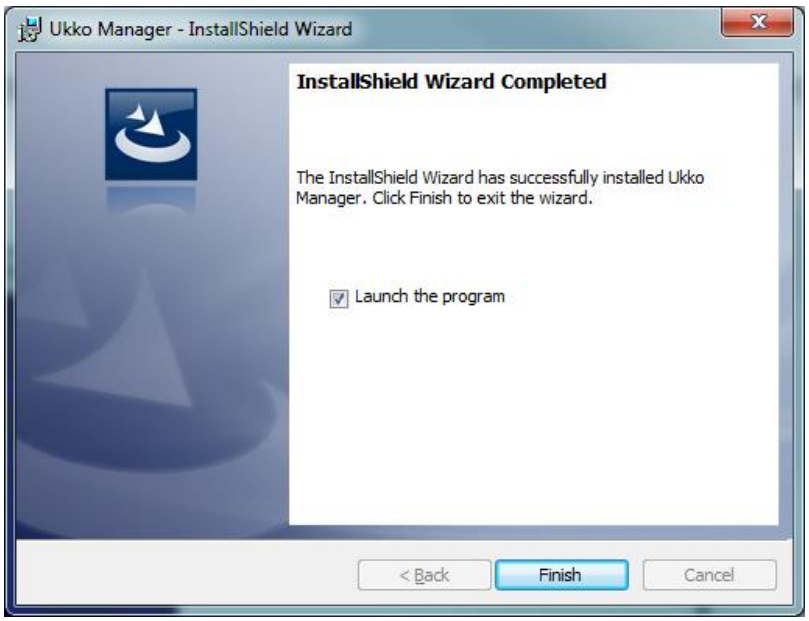
Ukko Manager - InstallShield Wizard
InstallShield Wizard Completed
The InstallShield Wizard has successfully installed Ukko Manager. Click Finish to exit the wizard.
Launch the program
< Back
Finish
Cancel

Figure 32. UKKO Manager Installation Completed

5.3 Launching the UKKO Manager

The installation creates shortcuts for *UKKO Manager* to the desktop and in the Start Menu. In the Start Menu the shortcut can be found at
Programs Menu ➔ Electriel ➔ UKKO Manager.

When launching the *UKKO Manager* for the first time, it will ask to choose a language. After choosing the language, the *UKKO Manager* installation is complete and the software is ready for use. Language can be changed later via the UKKO Manager menu.

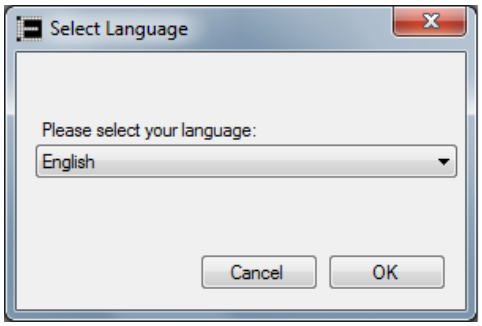

Figure 33. Select Language

5.4 Connecting UKKO MPPT to the Computer

UKKO MPPT can be connected with a USB cable to a computer at any time. *UKKO Manager* recognizes automatically when UKKO MPPT is connected and available, and starts synchronizing. The "Loading.." pop-up window indicates when synchronizing is completed. Wait until the "Loading.." window disappears.

Figure 34. Synchronizing Data with UKKO MPPT

5.5 General Overview

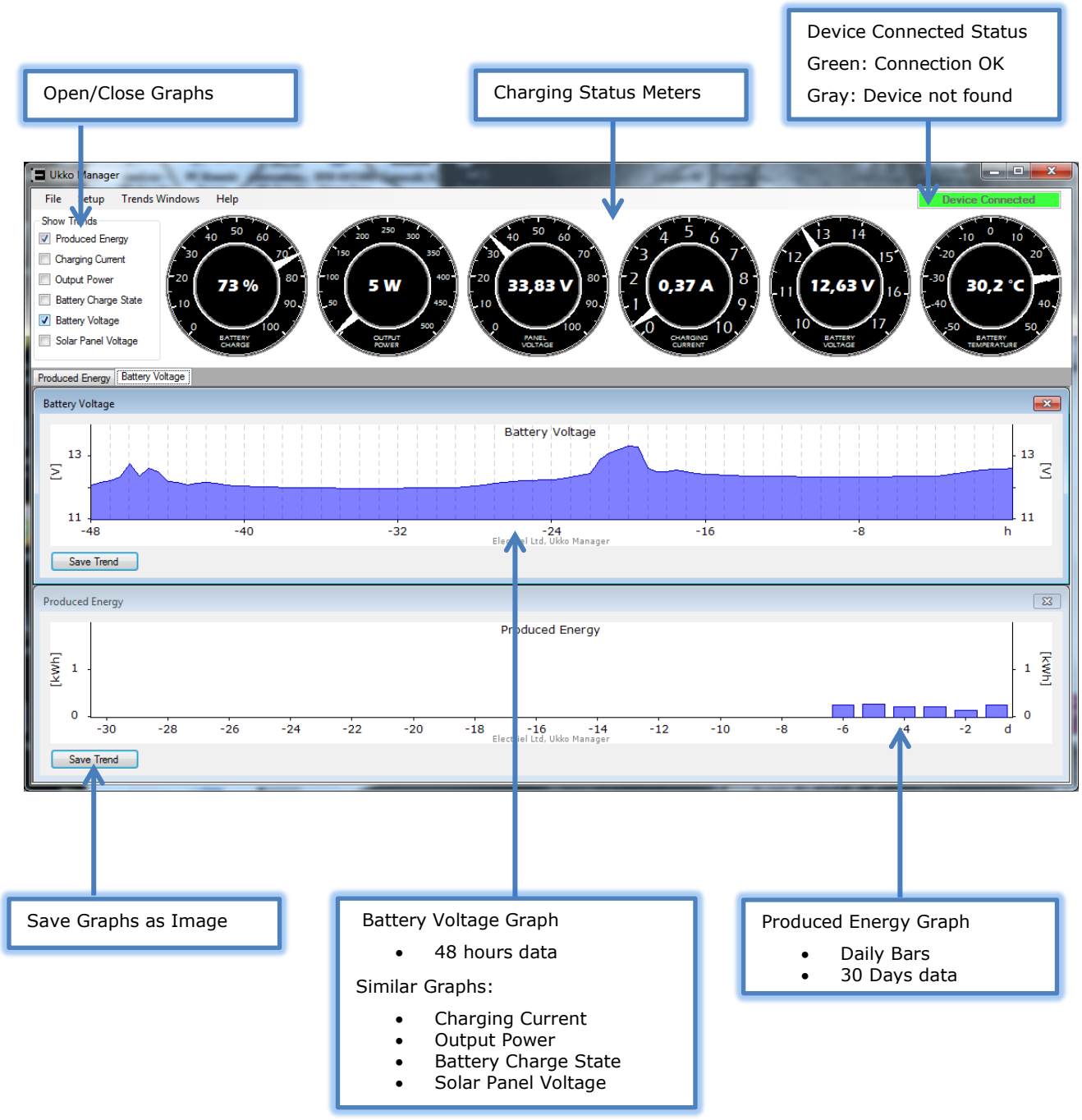

Figure 35. UKKO Manager

5.6 Changing UKKO MPPT Settings via UKKO Manager

Use *Ukko Manager* to configure UKKO MPPT. Access *UKKO Manager* setup menu after UKKO MPPT is connected to the computer. Go to ***Setup ➔ Device Parameters.***

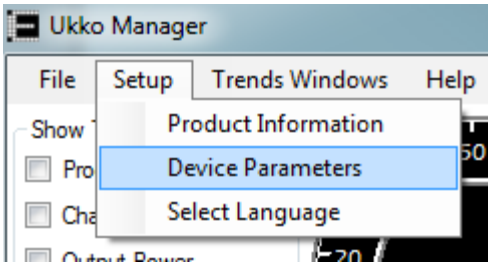

Figure 36. Open Device Settings Dialog

Now following dialog window will open.

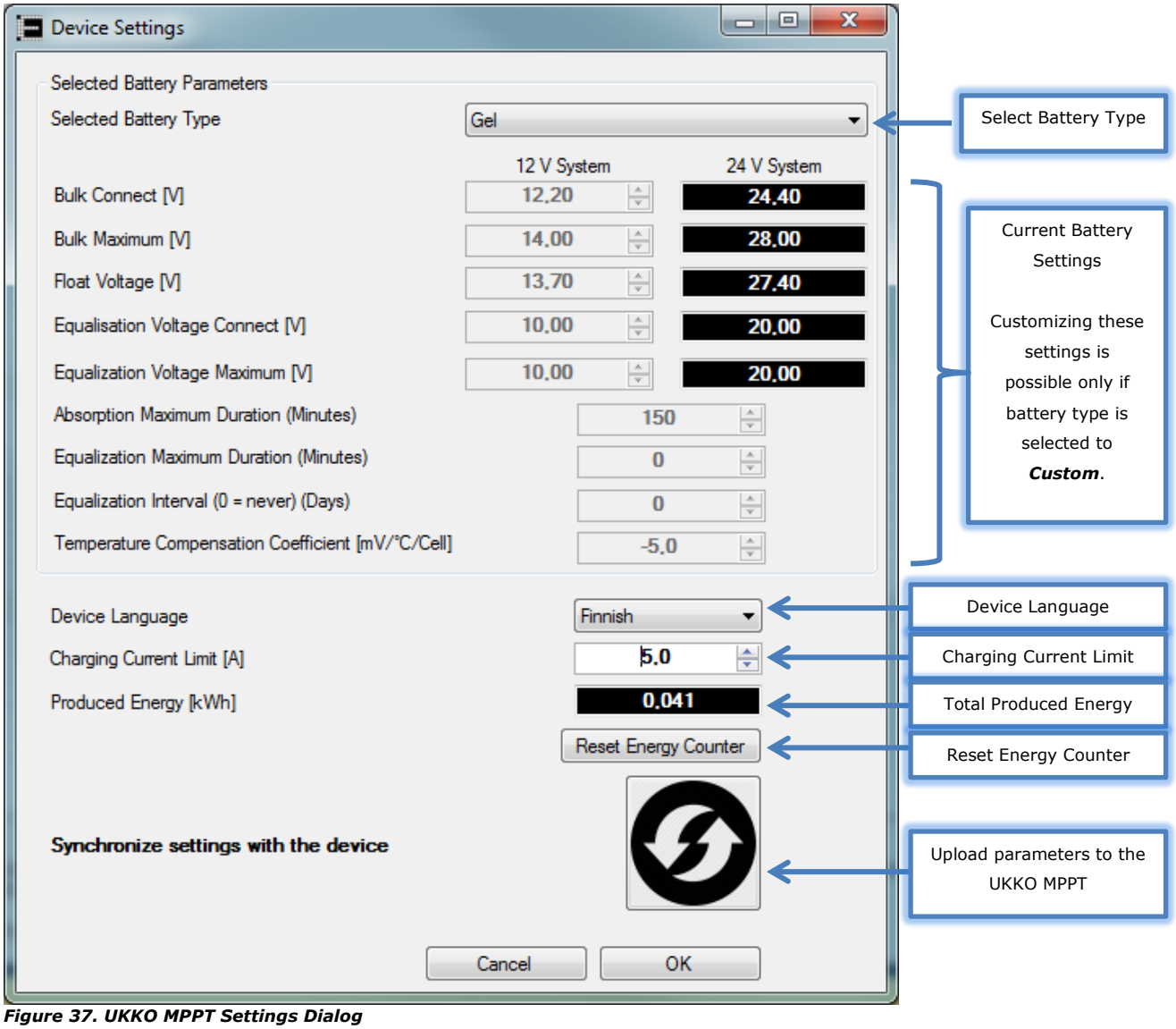

Figure 37. UKKO MPPT Settings Dialog

After changing the settings remember always to upload settings to UKKO MPPT by clicking the "Synchronize settings with the device" –button.

Figure 38. Synchronizing Data with UKKO MPPT

Wait until Loading pop-up window disappears in order to continue using the UKKO Manager. Don't disconnect USB cable during synchronizing!

CAUTION!

When using custom battery settings, please note that incorrect battery parameters and voltage limits may cause serious damage or even exploding of the battery! Before using custom settings, confirm with the battery manufacturer what are the correct parameters for the particular batteries in your system. Only advanced users, should use this feature. Use custom settings only at your own risk.

6 Troubleshooting

UKKO MPPT is designed to protect against damage to the controller or the system.

6.1 Protections

Over temperature

- If the heat sink temperature exceeds 80 °C it starts decreasing charging current until charging stops completely at 90 °C. Charging starts again when the heat sink is cooled down.

Battery overvoltage

- If the battery voltage exceeds its maximum limit (that is, 16 V in 12 V system) charging will be stopped until voltage has decreased back to its normal level.

Nominal Voltage

- If battery voltage goes too low or too high to unknown state which doesn't represent 12 V nor 24 V nominal system voltage the UKKO MPPT stops charging.

Battery Over temperature

- If battery temperature rises over 80 °C UKKO MPPT stops charging until it has cooled down back to normal level. This works only if a battery temperature sensor (BTS10) is enabled.

Solar Panel Overvoltage

- If solar panel voltage rises too high (more than 75 V) UKKO MPPT stops charging and warning will be shown on the display.

Solar Panel Overload

- If solar panel produces more power than the maximum output power of the UKKO MPPT is, it will limit the output current to maximum. (No indication on the display).

Solar Panel Short Circuit

- If solar panel wires are short circuited charging is stopped. Clear short to continue charging. (No indication on the display).

Battery Reverse Polarity

- UKKO MPPT is completely protected against reverse polarity. If battery is wired incorrectly no harm will be done to UKKO MPPT. Correct incorrect wiring to return to normal operation. (No indication on the display).

High Voltage Transients

- Solar panel, battery and load power connections are protected against high voltage transients. Transients are typical for instance during lightning. (No indication on the display).

Damaged Temperature Sensors

- If either internal (heat sink) or external battery temperature sensor is damaged the device stops charging. Display will show high temperature warning but if the device doesn't resume normal operation even when it's cooled down, temperature sensor is damaged and needs to be changed.

7 Warranty

The UKKO MPPT has a 24-month material and manufacturing warranty. The warranty is considered to start from the date of shipment to the end user. If a defect material in raw materials or a production flaw is found, the seller is obligated, when the product is sent to the seller without delay or before expiration of the warranty, to amend the mistake at his/her discretion either by repairing the defective product or by delivering free of charge to the buyer a new flawless product and sending it to the byer.

Delivery costs for the repair under warranty will be paid by the buyer. Proof of date and place of purchase must be provided. Seller will pay the return delivery cost if the repairs are covered by the warranty. To help rapid disposition of your warranty claim returned must include detailed reason of the failure, the model name, type of battery and system load.

Warranty Exclusions

This warranty does not comprise

- Damages caused by accidents.
- Improper or abnormal use.
- Flood and other natural phenomenon.
- Improper or careless handling.
- Damage occurred during shipment.
- Improper storage.
- PV or load currents exceeding the ratings of the product.
- Unauthorized product modification or attempted repair.

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